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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

CHAWAN, SHEELA C

ART UNIT PAPER NUMBER

2625

DATE MAILED: 04/07/2004

6

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/842,436

Applicant(s)

CHAPMAN ET AL.

Examiner

Sheela C Chawan

Art Unit

2625

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 April 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 19 is/are allowed.
- 6) ☒ Claim(s) 1-18, 20 and 21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 April 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) ✓
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 5. ✓

- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Preliminary Amendment

1. Preliminary amendment filed on 9/10/2001 has been entered.

Drawings Objections

2. The drawings are objected to because in fig 6, element 56 is miss spelled Murphology should be " Morphology ".

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

Art Unit: 2625

Claims 1, 2, 5-18, and 21, are rejected under 35 U.S.C. 103(a) as being unpatentable over Nichani et al. (US. 5,949,901) in view of Bartulovic et al. (US.6,177,682 B1).

As to claim 1, Nichani discloses a machine vision method for inspecting the surfaces of semiconductor substrate comprising:

illuminating the substrate from a first angle (column 4, lines 41- 50) and capturing a first image of the substrate (fig 2 A, item 22 and 24 includes lighting sources positioned to illuminating surface of the die 20), the first image comprising a plurality of pixels (fig 4, item 100 first image acquired, column 5, lines 53- 64), the pixels having an address, and a value, the address corresponding to a location on the substrate (an image inherently comprises a plurality of pixels, the pixels have values (their intensities) and having addresses corresponding to their location on the substrate (column 6, lines 17- 23);

illuminating the substrate from a second angle(column 4, lines 41- 50) and capturing a second image of the substrate (fig 4, item 102 column 2, lines 53- 65), the second image comprising a plurality of pixels, the pixels of the second image being addressed in the same manner as the pixels in the first image, and each pixel having a value (an image inherently comprises a plurality of pixels, the pixels have values (their intensities) and having addresses corresponding to their location on the substrate (column 6, lines 17- 23);

subtracting the pixel values from the first image from the pixel values in the second image on a pixel address by pixel address basis to create a third image (fig 4 item 112, column 5, lines 65- 67, column 6, lines 1- 7, 32-38) and;

processing the third image to determine the quantity of pixels (column 6, lines 17- 52) characteristic of three dimensional features therein and rejecting the substrate if the quantity pixels characteristic of three dimensional features exceeds a predetermined value.

Nichani discloses a machine vision method for inspecting the surfaces of semiconductor substrate. Nichani is silent about specifics details of determine the quantity of pixel characteristic of three dimensional features.

Bartulovic discloses a method and apparatus for the inspection of the BGA to determine if the components of the BGA or similar structure meet certain predefined parameters. Bartulovic uses multiple sources of illumination to illuminate the BGA at the same predetermined angle but from different directions and sources are positioned at equidistant angles from each other(column 2, lines 38- 46). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified Nichani to include a specifics details of determine the quantity of pixel characteristic of three dimensional features. It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified Nichani by the teaching of Bartulovic in order to perform sophisticated and fast analysis on the BGA and produce a three dimensional image of the BGA (as suggested by Bartulovic at column 2, lines 39 - 52).

As to claims 2 and 13, Nichani discloses a method for evaluating a substrate wherein a threshold is applied to the third image such that the pixel values are either zero or above the threshold (column 7, lines 4-8), such that the values above the threshold are characteristic of three dimensional features on the substrate, the threshold being applied prior to processing the third image to determine the quantity pixels of characteristic three dimensional features (column 3, lines 29- 49).

As to claims 5 and 14, Nichani discloses a method wherein the pixel addresses of all pixels in the third image which are above the threshold are recorded (column 7, lines 4-8).

As to claims 6 and 15, Nichani discloses a method for evaluating a substrate further comprising:

a selecting the minimum pixel value between the first and second images (column 6, lines 17- 67, column 7, lines 1- 14) on a pixel address by pixel address (an image inherently comprises a plurality of pixels, the pixels have values (their intensities) and having addresses corresponding to their location on the substrate) basis to create a fourth image (fig 4, item 112, subtracting the threshold image from the third image to generate a fourth image, column 6, lines 32- 38, 53- 60); and

processing the fourth image (fig 4, item 112, subtracting the threshold image from the third image to generate a fourth image, column 6, lines 32- 38, 53- 60), at and around the recorded pixel addresses (an image inherently comprises a plurality of pixels, the pixels have values (their intensities) and having addresses corresponding to

Art Unit: 2625

their location on the substrate), and rejecting the substrate if the processing falls outside predetermined tolerances (column 7, lines 4-14).

As to claims 7 and 16, Nichani discloses a method wherein the fourth image is processed with gray scale morphology (fig 4, item 116 , subtracting the threshold image from the third image to generate a fourth image, column 6, lines 32- 38, 53- 60)

As to claim 8, Nichani discloses a method for evaluating a substrate wherein the substrate is ceramic (column 1, lines 34- 50).

As to claim 9, Nichani discloses a method wherein the first and second images are captured by a single camera positioned perpendicularly above the substrate (fig 1, fig 2A and 2B).

As to claims 10 and 17, Bartulovic discloses a method wherein the first angle is between 10 degrees and 15 degrees from the horizon and the second angle is between 170 degrees and 165 degrees from the horizon (column 7, lines 49- 67, column 8, lines 1- 6).

As to claim 11, Bartulovic discloses a method wherein the three dimensional feature is manifested as a glint (reflection off the substrate is considered to be glint column 6, lines 1- 7).

As to claim 12, see the above rejection of claim 1.

As to claim 18, Nichani discloses an apparatus wherein the camera is a CMOS camera (column 4, lines 9- 40).

As to claim 21, Nichani discloses an apparatus wherein the processor is configured to apply gray scale morphology to the first image (fig 4, item 116, column 6, lines 45- 49).

4. Claims 3 – 4 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nichani et al. (US. 5,949,901) in view of Bartulovic et al. (US.6,177,682 B1) as applied to claims 1, 2, 5-18, and 21 above and further in view of King et al.(US.5,943,125).

Nichani discloses a machine vision method for inspecting the surfaces of semiconductor substrate. Nichani is silent about specifics details of threshold is set by a user.

King discloses a method and apparatus for illuminate one or more reflective elements , such as solder balls on an electronic component or other protruding surface or objects. The system comprises of :

a method for evaluating a substrate wherein the threshold is set by a user (column 5, lines 54- 64, column 10, lines 40- 47). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have modified Nichani to include a specifics details of threshold is set by a user. It would have been obvious to one of ordinary skill in the art at the time of the invention to have modified Nichani by the teaching of King in order to accurately measure the size and shape of individual reflective elements (as suggested by King at column 2, lines 52- 67).

As to claim 4, King discloses a method wherein the quantity of pixels characteristic of three dimensional data is determined by counting the pixel values which exceed the threshold (column 10, lines 40- 50).

As to claim 20, King discloses an apparatus wherein said first and second light sources are LED illuminators and the camera is a CMOS sensor (fig 3 and 4 item 50 , column 3, lines 4- 35, column 6, lines 11- 25).

Reason For Allowance

5. The following is an examiner's statement of reasons for allowance:

Regarding claim 19, the prior art of record fails to teach or suggest, alone or in combination, an apparatus for evaluating three dimensional features on a surface of a substrate, a processor configured to calculate the difference between the pixel values in the first image and the second image on a pixel address by pixel address basis to form a third image; the processor configured to apply a threshold to the third image such that the third image comprises a plurality of pixels, the pixels having an address and a value, the value being either zero or above the threshold, the processor operative in counting the number of non zero pixel values and causing the substrate to be rejected if the number of non zero pixels exceeds a predetermined value; if the number of non-zero pixel values is below the predetermined value the processor being operative to record the addresses of the non-zero pixel values and operative to calculate a fourth image, the fourth image being the lesser of each pixel value between the first and second images for each pixel address, the processor operative in evaluating the pixel values in the fourth image at the recorded locations to determine the size and

Art Unit: 2625

concentration of the pixel values and operative to reject the substrate if the size and concentration of the pixel values falls outside a predetermined tolerance.

Other prior art cited

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Chau et al. (US.5,859,698) discloses method and apparatus for macro defect detection using scattered light.

Hatab (US.6, 658,144 B1) discloses diffraction tomography for monitoring latent image formation.

Dotan (US.6, 353,222 B1) discloses determining defect depth and countour information in wafer structures using multiple SEM images.

Gordon (US.6, 256,088 B1) discloses apparatus and method for carrying out analysis of samples.

Hoki (US.5, 774,574) discloses pattern defect detection apparatus.

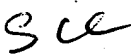
Nakajo et al. (US. 5,920,387) discloses apparatus and method for surface inspection.

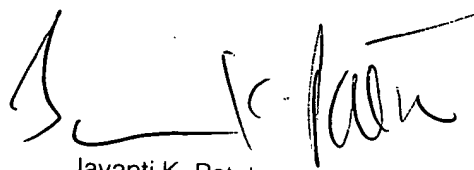
Contact Information

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sheela C Chawan whose telephone number is 703-305- 4876. The examiner can normally be reached on Monday - Thursday 6 - 7.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh Mehta can be reached on 703-308-5246. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Sheela Chawan
Patent Examiner
Group Art Unit 2625
April 2, 2004


Jayanti K. Patel
Primary Examiner